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“Application Behavior Management: A New Weapon in the Fight Against Costly Customized Software Failures”

NDIA/INCOSE Systems Engineering Conference

Presented by:

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Presentation Agenda

- Introduction and Credentials
- The Costs of Application Failure
- The Black Box
  - or “How can you manage what you can’t see?”
- ABM - Application Behavior Management
- Future Applications of ABM in Embedded Software Systems
- Questions

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- PATH started as a software consulting company in 1997 with a vision to solve software reliability problems and, after developing its technology, transitioned into a product company in 2000
- PATH's mission is to create enterprise-grade software tools that enable deployment of highly reliable, complex distributed applications
- Primary product: Path Application Manager (P.A.M.)
- Clients include federal government contractors, major ISPs, enterprise software vendors, eCommerce companies

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The Costs of Defects

- Typically 5 to 15 flaws in every 1,000 lines of code*
- Dealing with defects: **
  - Finding each bug takes about 75 minutes
  - Fixing bugs takes 2 to 9 hours per bug
  - On the outside, that's ~150 hours, or roughly $30,000 to cleanse every 1,000 lines of code

**Source: US Department of Defense and the Software Engi

**Source: A five-year Pentagon st

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The New Problem – Quality

- Distributed systems – leverage the power of multiple networked computer systems
  - Mainframe ⇨ client server ⇨ Internet + Web Service
- Proliferation of distributed systems
- Small scale applications
  - e.g., subsystems with embedded controllers that are software based

How can you manage what you can't see

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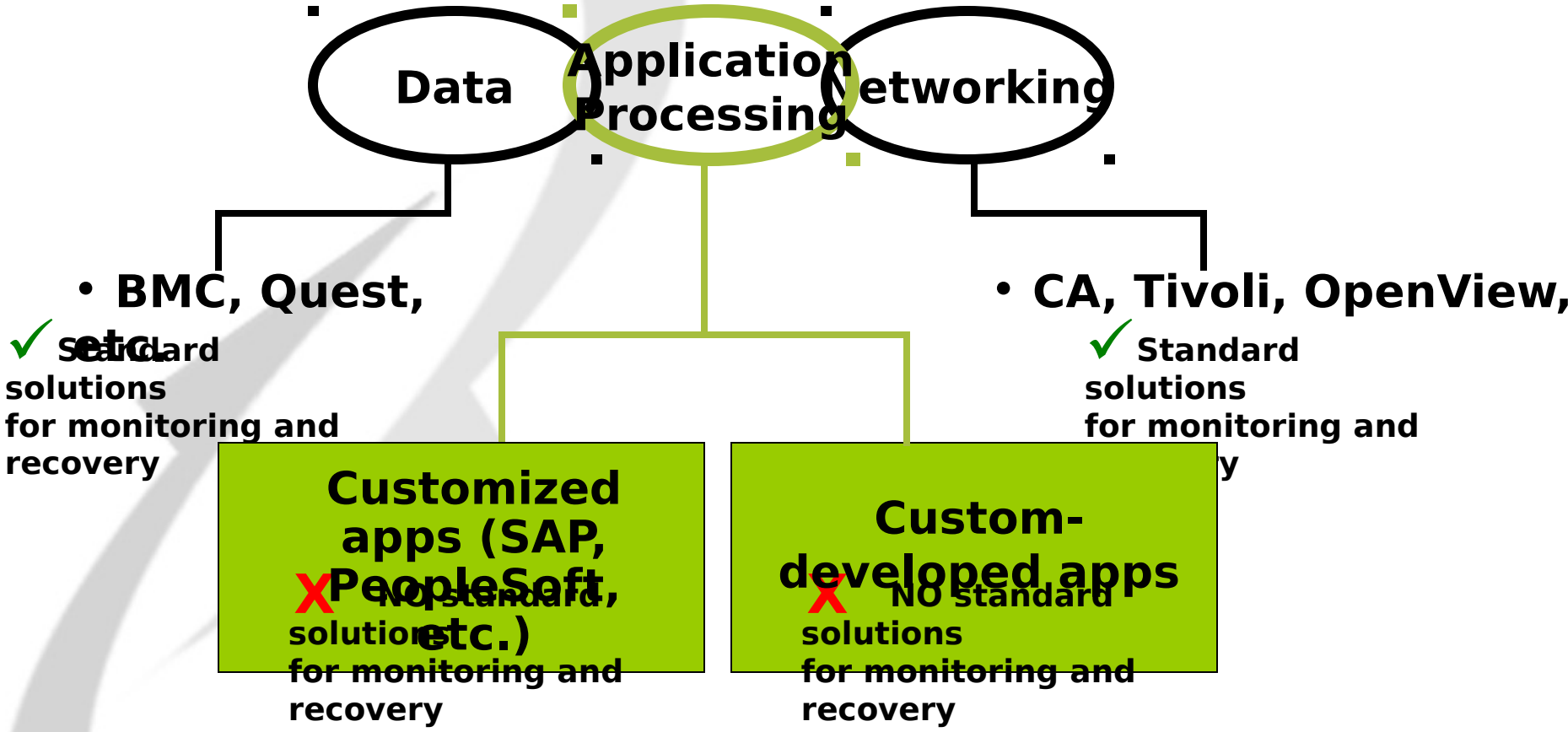
Enterprise Management Market Overview


Data
Application Processing
Networking
• BMC, Quest, etc.
✓ Standard solutions for monitoring and recovery
• CA, Tivoli, OpenView,
✓ Standard solutions for monitoring and
Customized apps (SAP, PeopleSoft, etc.)
X NO standard solutions for monitoring and recovery
Custom-developed apps
X NO standard solutions for monitoring and recovery

The area not addressed – *custom/customized, mission critical software applications* – is often the most important one

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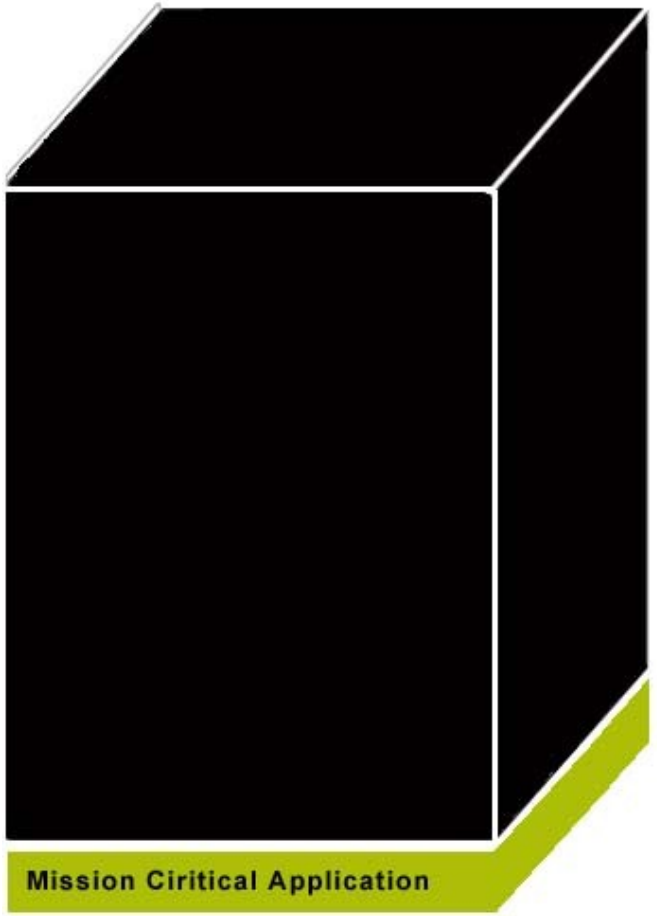
The Black Box

- Expensive domain knowledge required
- Avalanche of false alerts
- Are not time-related: 100% CPU at noon
- Does not provide root cause analysis
- Does not apply to QA or development cycles



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How can you manage what

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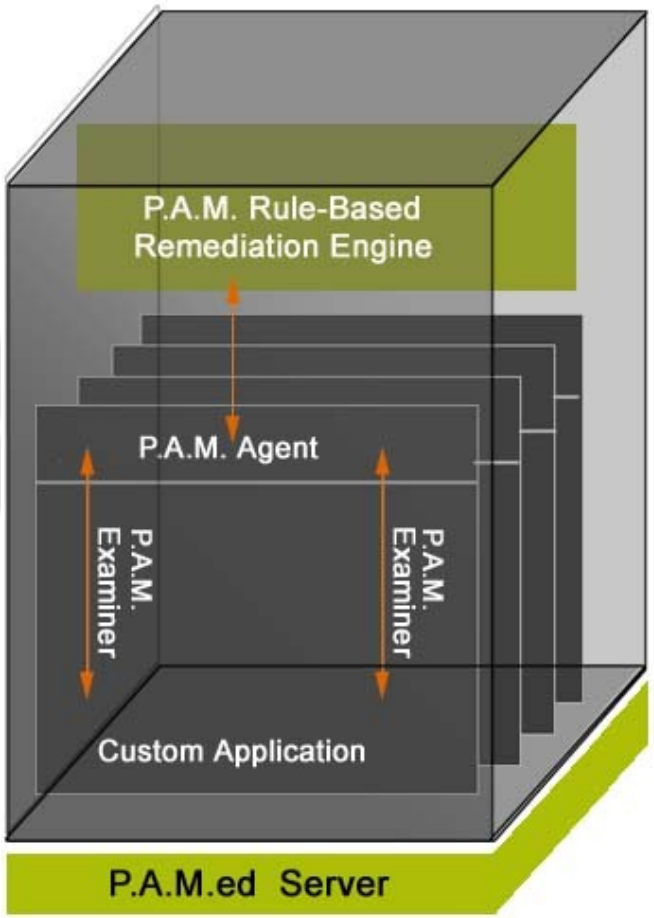
Turning the Black Box into a White Box



Data → Information → Intelligence

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Application Behavior Management

- Understand software patterns to be able to recognize anomalous patterns of software behavior
- Discover not only the problem, but how, where and when it first manifested itself
- Look deep into the software and see how it behaves while it is executing in real-time

Pattern recognition and fault detection can be deterministic with low overhead or footprint

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Challenges

- Collect the data without disturbing the software
- Differentiate between bugs and just abnormal usage
- Make intelligent use of data
- Store only what it needs
- Act on changing conditions as – or before – they occur

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Pattern Recognition and

- Pattern recognition is about comparing to a baseline – or to other patterns
- ABM tools have two kinds of patterns it uses:
  - General knowledge about software patterns
    - Typically built into the tool
    - Examples include: memory leaks, poor performance, high execution costs of code segments
  - Compare the software to itself
    - How does this version of the software compare to the previous one?
    - How is the test run compared to a production environment?

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ABM Tools – Required Features

- Anticipates application failures
- Provides both “federated health view” and granular visibility
- Automatically recovers failed applications
- Calendar sensitive – understands time of day, day of week, etc.
- Root cause analysis for distributed applications
- Intelligent data collection
- Used in entire lifecycle – development, testing, QA and production
- Heterogeneous language and platform support

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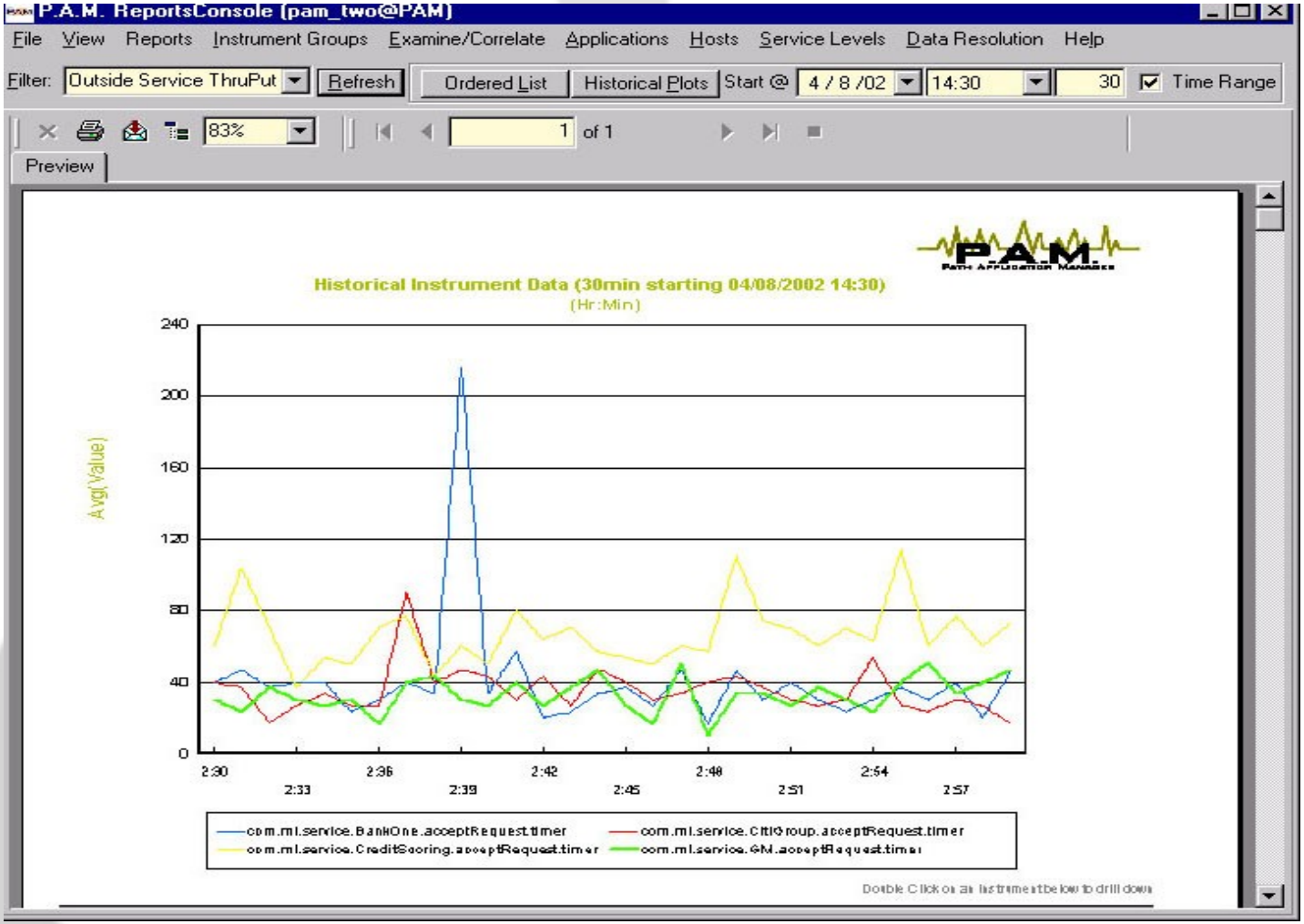
Data Mining for Software



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Methodology

- What happened?
  - Temporal examiner view of the application
- When did the problem occur?
  - Abnormal events
- Where in the application is the problem?
  - Problem manifestation
- Why did the problem occur?
  - Root cause

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New Applications in Customized Systems

- Identify faults
- Establish reference state
- Prove deterministic model
- Prove ability to do prognostics
- Overall health monitoring
- Challenge with today’s approach

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Benefits of using ABM

- Reduce the amount of code written
- Improve quality of testing
- Accelerate defect fix rate due to superior diagnostics of the software
- Increase system testability
- Improve in-the-field diagnostics of unexpected conditions

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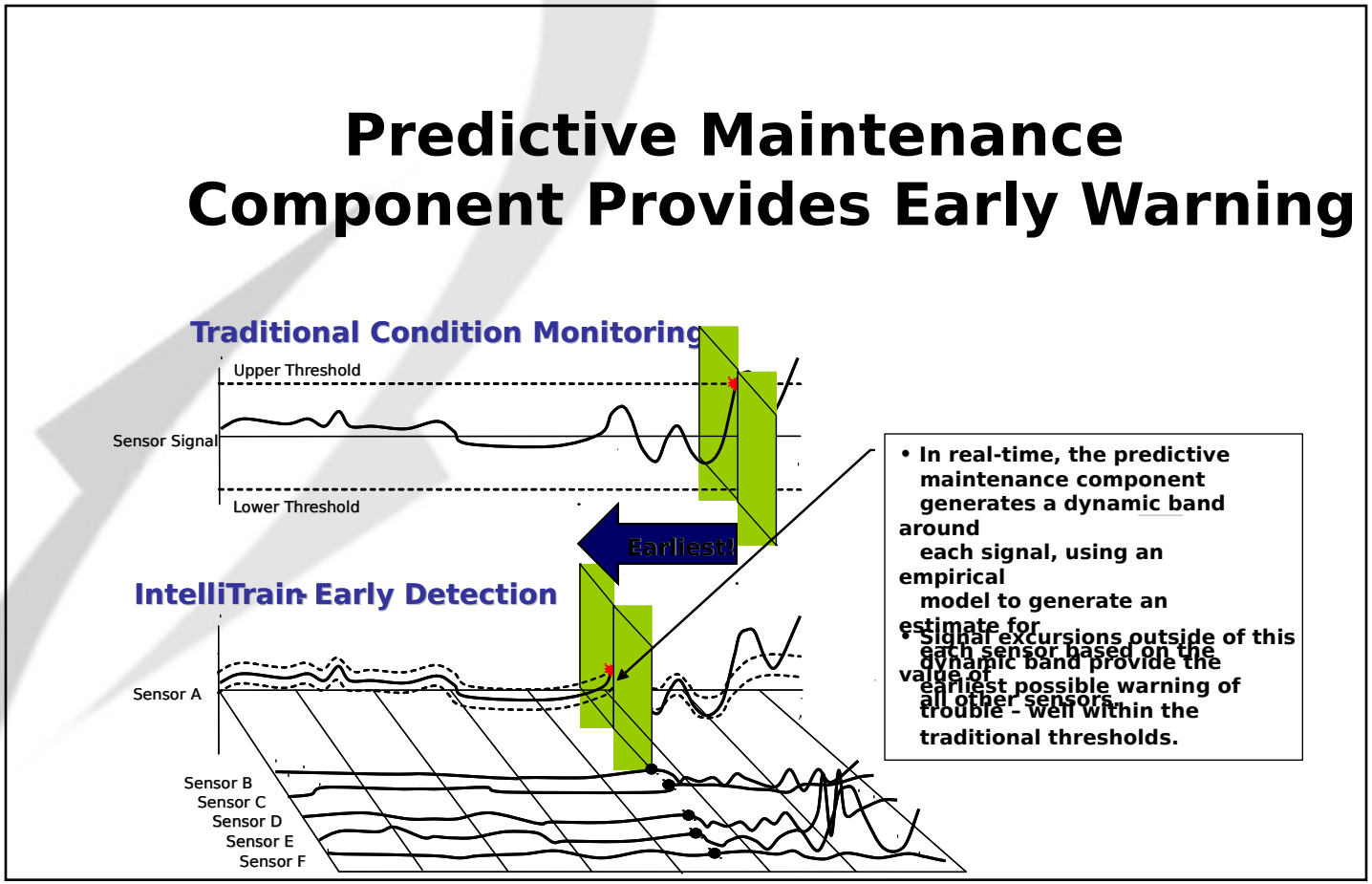
Simple Maintenance Example


Predictive Maintenance
Component Provides Early Warning
Traditional Condition Monitoring
Upper Threshold
Sensor Signal
Lower Threshold
Earliest!
IntelliTrain Early Detection
Sensor A
Sensor B
Sensor C
Sensor D
Sensor E
Sensor F
• In real-time, the predictive maintenance component generates a dynamic band around each signal, using an empirical model to generate an estimate for each sensor based on the value of all other sensors.
• Signal excursions outside of this dynamic band provide the earliest possible warning of trouble – well within the traditional thresholds.

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Example: IntelliTrain Key Findings

- 80% of potential mission failures were detectable via IntelliTrain prior to functional failure
- None were detectable prior to IntelliTrain
- 50% of potential mission failures were detected and corrected before the mission failure occurred
- The implementation of this process led to a 70% reduction in “No Defect Found” and a sustained increase in fleet availability

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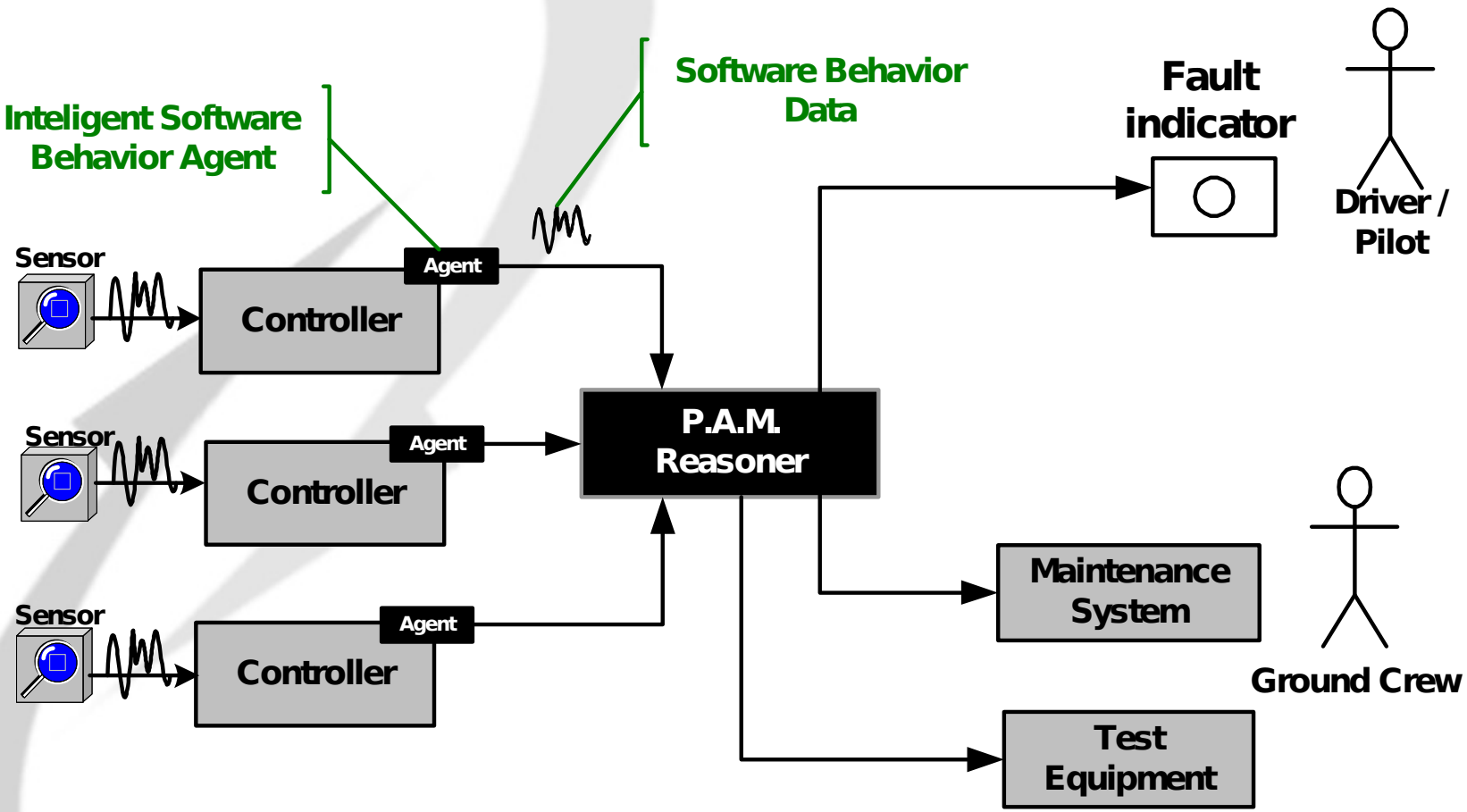
Improved ABM Approach



Note: This is layered on top of the traditional signal pr

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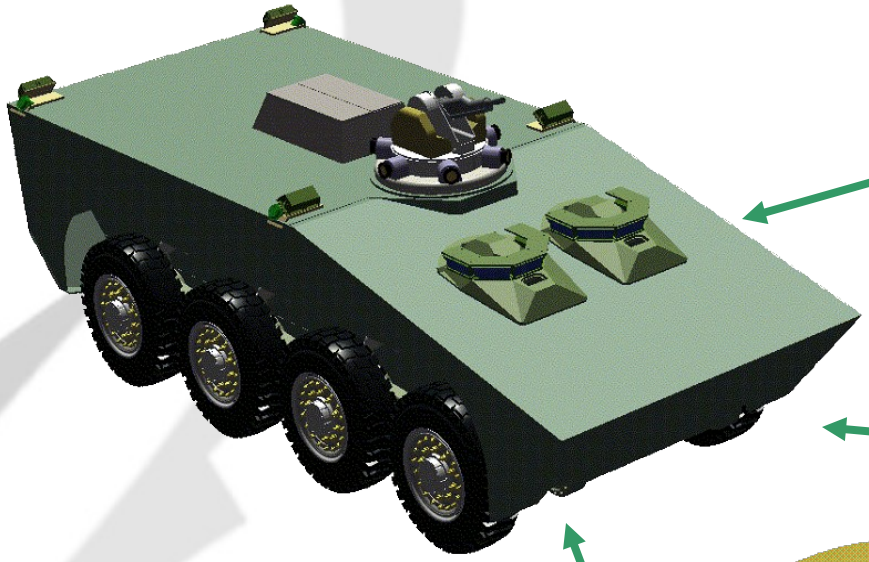
Vehicle of the Future

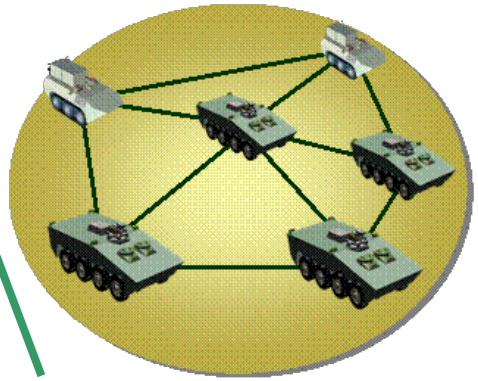


ABM in back-office applications

ABM in steering

ABM in engine

ABM in brakes



ABM in satellite

ABM in supervisory unit

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ABM Benefits with Software S

- Software sensors are added to embedded code
  - Include data from hardware sensors as well as the software logic execution patterns
- ABM can be interfaced between any number of controllers/subsystems
  - Can identify faulty subsystems or aberrant behavior of components
  - Minimal domain expertise is necessary
- Approach can be used on existing systems, e.g., IntelliTrain, as well as futuristic systems, e.g., Future Combat Systems
- COTS software available NOW and can be used for a variety of applications

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Questions ?

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